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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/851,313	05/09/2001	Tatsuya Usami	NEC01P069-MSb	2820

21254 7590 01/26/2005

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EXAMINER	
MALDONADO, JULIO J	
ART UNIT	**PAPER NUMBER**
2823	

DATE MAILED: 01/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/851,313	USAMI, TATSUYA	
	Examiner	Art Unit	
	Julio J. Maldonado	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 September 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-6,8 and 31-46* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-6,8 and 31-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The rejection as set forth in the Office Action mailed on 06/15/2004 is withdrawn in view of applicants' amendments and arguments.

2. A new rejection is included in this Office Action.

3. Claims 1, 2, 4-6, 8 and 31-46 are pending in the present application.

Continued Examination Under 37 CFR 1.114

4. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 09/15/2004 has been entered.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 2, 4-6, 8, 31, 34, 37-42, 44 and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lou (U.S. 6,277,732 B1) in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane).

Lou (Figs.1A, 1B, 1D and 1E) teaches a damascene interconnect including a multilayered insulation film, wherein said multilayered insulation film comprises a first insulation layer (208) comprising spin on glass materials such as aromatic-containing organic resins having a dielectric constant no greater than 3.5; a second insulation layer (210) comprising a polysiloxane compound having an Si-H group and formed on and adhering to a top of said first insulation layer (208); a third insulation layer (212) made of silicon oxide and formed on and adhering to a top of said second insulation layer (210); and a conductive wire (216, 218) embedded in a groove formed in said multi-layered insulation film, said multi-layered insulation film being disposed between said wire (216, 218), wherein said first insulation layer (208) comprises a thickness greater than a thickness of said second insulation layer (210); and wherein said first insulation layer (208) comprises a thickness greater than a thickness of said third insulation layer (212), wherein a bottom of said groove is formed on a same surface as said first insulation layer (208) and wherein a surface of said multi-layered film is substantially coplanar with a surface of said plurality of wires (column 3, line 5 – column 4, line 60).

Although Lou does not expressly disclose forming a plurality of grooves, this feature is seen to be inherent because the interconnection structure of Fig.1E would have multiple vias as the interconnection structure is continuously showing.

Still, Lou fails to teach wherein said second insulation layer comprises a hydride organosiloxane, such as methylated hydrogen silsesquioxane film (MHSQ) at a thickness of about 50nm, wherein said dielectric layer includes repeating units of $(SiCH_3O_2)_n$, $(SiO_2H)_n$ and $(SiO_3)_n$, wherein a molar ratio of $(SiO_2H)_n$ to a total of said

repeating units is at least 0.2, wherein said dielectric layer is deposited by plasma CVD, and wherein said plurality of wires comprise copper wires. However, Allada et al. (Figs.1a-1b) in a related art to the formation of copper interconnect structures teach a second insulating film comprising a methylated hydrido organo siloxane polymer (HOSP), wherein said polymer can be formed by spin coating processes or by conventional CVD processes (column 2, lines 7 – 67).

Furthermore, according to Chen (Fig.1), methylated hydrido organo siloxane polymer (HOSP) includes repeating units of $(SiCH_3O_2)_n$, $(SiO_2H)_n$ and $(SiO_3)_n$, wherein a molar ratio of $(SiO_2H)_n$ to a total of said repeating units is at least 0.2.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use the insulating layer as taught by Allada et al. in the interconnect formation structure of Lu et al., since this dielectric layers exhibit low dielectric constants (Allada et al., column 2, lines 36-48). It would also have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Lou and Allada et al. to enable using copper as the metal interconnect structure of Lou as taught by Allada et al.

Furtherstill, the combined teachings of Lou and Allada et al. fail to teach wherein said second insulation layer comprises a layer to improve adhesion property between said first insulation layer and said third insulation layer. However, the same materials are treated the same way and thus the same result is obtained.

Still, the combined structure of Lou and Allada et al. fail to teach the dielectric layer having a thickness of about 50nm. Notwithstanding, it would have been an

obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension. Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, In re Rose, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); In re Rinehart, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); In re Dailey, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

7. Claims 32 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lou (U.S. 6,277,732 B1) in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane) as applied to claims 1, 2, 4-6, 8, 31, 34, 37-42, 44 and 46 above, and further in view of The Applicants Admitted Prior Art.

The combined teachings of Lou and Allada et al substantially teaches all aspects of the invention including a first dielectric layer comprised of spin on glass (SOG) materials, but fails to disclose wherein said SOG are organopolysiloxane including methyl silsesquioxane (MSQ); and wherein said plurality of wires comprise copper

wires. However, the prior art teaches using SOG materials as dielectric layer, wherein said SOG materials include methyl silsesquioxane (Instant page 2, lines 5 – 8 and page 5, lines 9 – 24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Lou and Allada et al. with the teachings of the prior art to substitute the SOG material taught by the combination of Lou and Allada et al. for the SOG material disclosed by the prior art because using MSQ reduces crosstalk between metal wires (Instant page 2, lines 12 – 15).

8. Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lou (U.S. 6,277,732 B1) in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane) as applied to claims 1, 2, 4-6, 8, 31, 34, 37-42, 44 and 46 above, and further in view of Aoi (U.S. 6,333,257 B1).

The combined teachings of Lou and Allada et al. teach all aspects of the invention including a first dielectric layer selected form a material including fluorinated polyimide but fail to teach using first insulation layer comprising polyaryl ether. However, Aoi (Figs.4a-11c) teaches a multilayered insulation film having wiring embedded therein, wherein interlayer insulation layer (204) comprises any arbitrary material such as fluorinated polyimide and polyaryl ether (column 10, lines 1 – 11). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Lou and Allada et al. with the teachings of Aoi to enable using the dielectric

materials of Aoi in the combination of Lou and Allada et al. because one of ordinary skill in the art at the time the invention was made would have been led to the conclusion that the selection of known materials based on its suitability for its intended use supported a prima facie obviousness. MPEP 2144.07.

9. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lou (U.S. 6,277,732 B1) in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane) as applied to claims 1, 2, 4-6, 8, 31, 34, 37-42, 44 and 46 above, and further in view of Yau et al. (U.S. 6,072,227).

The combination of Lou and Allada et al. teach a multilayered insulation film including an adhesive layer between two interlayer dielectrics, but fails to disclose wherein said adhesive layer comprises a first layer and a second layer placed in said first layer. However, You et al. (Figs.8H and 10H) teach a damascene structure comprising a multilayered insulation film, wherein said multilayered insulation film comprises a first dielectric layer (710) that can be made of an organic material having a dielectric constant which is lower than a silicon oxide dielectric constant (column 14, lines 10 – 14); a second dielectric layer (714, 716, 718) comprising an oxidized organic silane layer (column 14, lines 20 – 22); and a third dielectric layer (722) that can be made of an inorganic material (column 13, lines 9 – 13), wherein said adhesive layer comprises a first layer (714) and a second layer (718) placed in said first layer, wherein said first (714) and said second (718) layer are made from the same material (column

13, line 9 – column 14, line 59). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Lou and Allada et al. with Yau et al. to enable the second dielectric layer of Lou and Allada et al. to be comprised of more than one layer according to the teachings of Yau et al. because it is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition to be used for the very same purpose (MPEP 2144.06).

10. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lou (U.S. 6,277,732 B1) in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane) as applied to claims 1, 2, 4-6, 8, 31, 34, 37-42, 44 and 46 above, and further in view of Lu et al. (U.S. 6,008,540).

The combined teachings of Lou and Allada et al. substantially teaches all aspects of the invention but fails to disclose wherein said first insulation layer, said second insulation layer and said third insulation layer of said multi-layered insulation film comprise substantially uniform widths. However, Lu et al. (Figs.2b and 3f) teach an interconnect structure comprising a multi-layered insulation film formed on a semiconductor substrate (102), said multi-layered insulation film comprising a first insulation layer comprising an organic material (342, and column 1, lines 24 – 33) having a dielectric constant which is lower than a silicon oxide dielectric constant; a second insulation layer (344) comprising a polysiloxane compound having an Si-H

group and formed on and adhering to a top of said first insulation layer (342); a third insulation layer (346) comprising an inorganic material and formed on and adhering to a top of said second insulation layer (344); and a plurality of wires embedded in a groove formed in said multi-layered insulation film, said multi-layered insulation film being disposed between said wires, said first insulation layer, said second insulation layer and said third insulation layer of said multi-layered insulation film comprise either uniform or non-uniform widths (column 3, line 48 – column 6, line 62).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Lou and Allada et al. with the teachings of Lu et al. to enable the dielectric layers of Lou and Allada et al. to be configured according to the teachings of Lu et al. because it would be a matter of choice which a person of ordinary skill in the art would have found obvious absent persuasive evidence that a particular configuration was significant. MPEP 2144.04, IV, B.

11. Claim 45 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lou (U.S. 6,277,732 B1) in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane) as applied to claims 1, 2, 4-6, 8, 31, 34, 37-42, 44 and 46 above, and further in view of Wolf et al. (Silicon Processing for the VLSI Era, Volume 1).

The combined teachings of Lou and Allada et al. teach wherein said second insulation layer, i.e., the hydride organosiloxane was formed by conventional CVD techniques (Allada et al., column 2, lines 49 – 67), but fail to disclose wherein said

conventional CVD processes include plasma CVD. However, according to Wolf et al., conventional CVD processes known in the art includes low pressure CVD and plasma CVD (pages 168 – 174). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Lou and Allada et al. with the teachings of Wolf et al. to enable the deposition step of Lou and Allada et al. to be performed according to the teachings of Wolf et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed deposition step of Lou and Allada et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.

13. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final submissions and the customer service number for group 2800 is (703) 306-3329. Updates can be found at http://www.uspto.gov/web/info/2800.htm.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
January 11, 2005

George Fourson
Primary Examiner